REMARKS

Claim 1 has been amended to describe a carbon containing refractory piece. Support for this amendment may be found, for example, at page 5 lines 16-17, describing an alumina-graphite piece. Graphite is simply one form of carbon. A carbon-containing refractory piece is, therefore, described in the specification, and amended claim 1 contains no new matter. Applicants have added new claims 14-18. Claims 14-17 depend from claim 1. The subject matter of claims 14-17 corresponds to cancelled claims 9-11 and 13, and does not represent new matter. Claim 18 represents original claim 1.

Section 102 Rejections

Bouchemousse

The Examiner has rejected claim 1 under 35 USC 102(b) in light of US 5,350,609 to Bouchemousse. Bouchemousse teaches a refractory article having at least one molten metal contacting layer comprising dense fused silica and a refractory foam layer bonded by a fired ceramic bond to the metal contacting layer. Applicants do not believe Bouchemousse anticipates the present application.

Bouchemousse attempts to reduce thermal losses from the refractory article, thereby avoiding excessive superheating and permitting molten metal to arrive at its destination at the desired temperature. See col. 1, line 14-20. Bouchemousse provides a foamed refractory material bonded to a dense fused silica, and describes this structure as reducing thermal conductivity without external insulation, which had been used by the prior art.

Anticipation exists where a single reference teaches, either expressly or inherently, each and every claimed element as interpreted by one of ordinary skill in the

art. Claim 1 of the pending application teaches a refractory piece covered at least in part by an insulating coating and the insulating coating covered at least in part by a glaze coating. Bouchemousse does not include all three components of the present application, namely a refractory piece, an insulating coating, and a glaze, and cannot anticipate claim 1 or new claim 18.

The Examiner argues the fused silica metal contacting layer of Bouchemousse functions as a glaze. Applicants disagree with this characterization because the fused silica layer comprises the primary mechanical strength of the article. See col. 3-4 lines 38-2 (identifying the fused silica layer with high strength properties and the foam layer with thermal insulation). A glaze typically imparts no mechanical strength. Assuming the fused silica layer is a glaze, Bouchemousse teaches an article consisting of a foamed core covered at least in part by a glaze. A refractory piece is not present. Lacking even one claimed element, that is either the refractory piece or the glaze, Bouchemousse cannot anticipate claims 1 or 18.

Additionally, amended claim 1 teaches a carbon-containing refractory piece. Bouchemousse does not describe and could not comprise a carbon-containing refractory piece. Bouchemousse teaches sintering a raw or green article to obtain a hard refractory article comprising fused silica. See col. 3 lines 24-28. Bouchemousse does not identify a sintering temperature; however, for practical purposes, sintering fused silica requires a temperature exceeding 1000 C. See, e.g., HANDBOOK OF CHEMISTRY AND PHYSICS, 74th ed., Donald R. Lide, ed., CRC Press ((1993) 4-95 (showing the melting points of the various forms of silica to exceed 1600 C). In any case, Bouchemousse must sinter at greater than 700 C because, as indicated by the claims, the article is stable enough at this

temperature to obtain a thermal conductivity measurement. At such temperatures, one skilled in the art would know that, in the absence of a reducing atmosphere, carbon forms fugitive oxides, thereby leaving a carbon-free article. Cf. US 5,691,061 to Hanse *infra* (describing the firing of a carbon-containing liner at a temperature above 1000 C, thereby oxidizing the liner and producing a carbon-free surface). Bouchemousse sinters the article, and sintering precludes a carbon-containing refractory piece.

Bouchemousse teaches a sintered article having only two components, namely a dense layer and a foamed layer. Assuming the dense layer is a glaze, the article does not include a refractory piece. Even if the Examiner can identify a refractory piece, Bouchemousse cannot comprise a carbon-containing refractory piece. In contrast, claim 1 requires a carbon-containing refractory piece. Lacking even one element of the pending claim, Bouchemousse cannot anticipate the present invention.

Hanse

The Examiner has rejected claims 1-3 and 6 as anticipated by US 5,691,061 to Hanse. Hanse teaches a refractory article having a bore defined by a carbon-free liner. The liner is made carbon-free by heating to a temperature above 1000 C. Commonly, this is accomplished during preheating by directing a flame into the bore of the nozzle. The drawings show a typical submerged entry nozzle, including a refractory piece (2) and slag-line sleeve (8). The sleeve comprises "a material resistant to erosion by the mold powder layer covering the top of the mold." Col. 4 lines 27-28. A glaze may be applied externally on the piece. See id. lines 37-40.

In one embodiment, Hanse shows a refractory piece, a sleeve over at least a portion of the piece, and a glaze over at least a portion of the sleeve. The Examiner

argues the sleeve is an insulating coating. Applicants strongly disagree with the Examiner's presumption regarding the sleeve and submit that the Examiner has misunderstood Hanse. Hanse does not teach or suggest that the sleeve is a thermally insulating structure. Hanse teaches only that the sleeve is "resistant to erosion."

The Examiner has provided no teaching that correlates erosion resistance and insulation resistance. In fact, these two properties are often inversely related, that is, (1) high porosity improves thermal insulation while decreasing erosion resistance and (2) higher density (and lower porosity) often correlates with greater erosion resistance while decreasing insulation value. Bouchemousse *supra* at least implicitly recognizes this fact. Bouchemousse includes a layer of dense fused silica over a foamed, porous material. The outer layer of dense fused silica produces an article with a smooth outer surface that "resists corrosion and erosion by molten metals." Col. 3, lines 35-36. By implication, the foamed, porous material, which is more thermally insulating, is more susceptible to corrosion and erosion. A slag-line sleeve must be resistance to erosion. This necessary feature of a slag-line sleeve argues against the Examiner's description of the sleeve as an insulating coating.

The Examiner also cannot conclude that the sleeve is thermally insulating based on composition. The composition of the body of Hanse and the sleeve of Hanse need not differ significantly in terms of thermal insulation. Hanse describes the body of the refractory piece as comprising "a traditional refractory material, e.g., a material comprising 20-30% carbon and one or more refractory oxides such as alumina, <u>zirconia</u>, silica, magnesia and the like." Hanse at col. 4 lines 34-37 (emphasis added). Hanse describes the sleeve only as "a material resistant to erosion by mold powder." *Id.* at col.

4 line 27. One skilled in the art would recognize that zirconia-graphite is a "material resistant to erosion by mold powder" and a slag-line sleeve often comprises zirconia-graphite. See, e.g., US 5,370,370 to Benson, col. 6 lines 9-11 (describing a slag-line sleeve of zirconia-graphite); US 5,185,300 to Hoggard et al., col. 1 lines 62-66 (describing as common practice a slag line sleeve comprising zirconia and graphite).

Consequently, the refractory body of Hanse may comprise zirconia-graphite and the sleeve may also comprise zirconia-graphite. One skilled in the art would expect the thermal properties of the body and the sleeve to be similar. The sleeve of Hanse is clearly not intended as a thermally insulating structure nor does it function as an insulating coating. Hanse lacks a claimed element of the present invention. The Examiner must remove her 102(b) rejection based on Hanse.

Benson

The Examiner has rejected claims 1-2 and 6 as anticipated by US 5,370,370 to Benson. The rejection does not explain how Benson anticipates the present invention, that is, how Benson includes every claimed element of the present invention. Applicants request clarification from the Examiner.

The Examiner does identify Benson as showing a refractory body coated with a glaze. A carbon-free liner is also present that reduces alumina build-up during casting. Applicants assume the Examiner interprets Benson so that the liner, refractory body and glaze correspond respectively to the refractory piece, insulating coating, and glaze of the present invention.

Arguments made above regarding Hanse are also applicable with Benson. Benson is not concerned with insulation and does not describe an insulating coating. The

Examiner has not explained how the Benson liner functions as a refractory piece or how the Benson refractory body functions as an insulating coating. The Examiner has simply cited an article comprising three layers of materials, but has not explained how these materials anticipate the present invention.

Applicants submit that the refractory body and liner do not differ significantly in thermal conductivity. The refractory body comprises alumina-graphite or zirconia-graphite. See col. 3 lines 6-8. The liner comprises a carbon-free material such as alumina or zirconia. See claim 2, col. 8 lines 40-43. It is not apparent how such materials would differ in thermal conductivity. See, e.g., HANDBOOK OF CHEMISTRY AND PHYSICS, 74th ed., David R. Lide, ed., CRC Press, Inc., 12-141 (1993) (showing thermal conductivities of alumina, graphite and zirconia to be, in W/m K, 6, 1.3 and 2.5 at steel casting temperatures.) The refractory body is not an insulating coating within the meaning of the present invention.

Finally, under the assumptions made by the Applicants, the carbon-free liner of Benson would correspond to the carbon-containing refractory piece of the present application. Clearly, Benson would not anticipate amended claim 1 where Benson expressly requires the refractory piece to by carbon-free.

For all of the above reasons, individually, Benson does not anticipate claims 1-2 and 6.

Yamamura

The Examiner has rejected claim 1 as anticipated by US 5,908,577 to Yamamura. Yamamura teaches a nozzle having a liner comprising 5-70% cordierite and 1-10% carbon. The liner is described as reducing alumina build-up during steel casting. The

Examiner believes the liner acts as an insulting coating that, when fired, "inherently produces a glaze over [the liner]."

The Examiner statement is without support in Yamamura and is erroneous from a technical perspective. Yamamura is unconcerned with glazing, and the word "glaze" is not found in Yamamura. The Examiner cites col. 9, lines 55-60 for an implicit teaching of glaze, but this clause teaches the firing of a green body in a non-oxidative atmosphere and machining the fired product to obtain a submerged entry nozzle. Firing and machining do not implicitly produce a glaze. A glaze is most typically applied as a liquid to the surface of an article. Unfortunately, glazes do not spontaneously appear where needed. The Examiner must support her statement that firing inherently produces a glaze, or she must withdraw this basis for rejection of claim 1.

The liner of Yamamura is also on the inner surface of the refractory piece. Claim 1 of the present invention requires the insulating coating to be on the outer surface of the piece. This distinction alone is sufficient to overcome the Examiner's rejection of claim 1. In practice, an insulating coating on the inner surface would be counterproductive. As described in the specification, preheating involves applying heat to the inner surface of the piece, thereby reducing thermal shock to the piece when inserted into the casting stream. Heat permeates into the piece and the insulating coating on the outer surface retains the heat in the piece. Placing the insulation on the inner surface would decrease the effectiveness of preheating by reducing heat transfer to the piece. The lack of insulating coating on the outer surface would permit heat to escape from the piece, thereby reducing the effectiveness of preheating. Yamamura does not teach a refractory piece at least partially coated by an insulating coating which is at least partially coated by

a glaze. The liner of Yamamura is not analogous to the insulating coating of the present invention. Applicants request removal of Yamamura as an anticipating reference.

103 Rejection

Claims 2-6 are rejected as obvious over Yamamura, *supra,* in light of US 4,559,270 to Sara and US 5,252,526 to Whittemore. Claim 1 is the sole independent claim. Claims 2-6 depend from claim 1 and are allowable as dependent claims of an allowable claim.

Claims 2-6 are also allowable over the cited art because the cited art does not fairly teach all elements of the claims to one of ordinary skill in the art. Yamamura teaches a submerged entry nozzle having a liner. Sara describes a glaze for use on a carbonaceous article. Whittemore describes a refractory mix for forming a brick comprising hollow ceramic microspheres.

A prima facie case of obviousness exists only when the prior art, alone or in combination, teaches each element of a claim and fairly suggests the combination of such elements to one skilled in the art. Here, the cited art does not teach an insulating coating, or the combination of required elements, or the particular configuration taught by the present invention. Further, the cited art provides no basis to combine these references.

The Examiner cites Whittemore because of the use of microspheres and concludes "it would have been obvious to one of ordinary skill in the art to modify the nozzle of Yamamura to include microspheres to reduce cost." Whittemore does teach microspheres but does not teach an insulating coating. Whittemore incorporates the microspheres into a refractory article, namely a brick. In contrast, the present invention applies an insulating coating comprising microspheres onto the outer surface of a

refractory piece and does not incorporate microspheres into the refractory piece. Absent any teaching of an insulating coating applied to an outer surface, the cited references cannot obviate claims 2-6.

Even assuming Whittemore describes an insulating coating, the cited art still does not obviate the pending application. Reconstruction of the present invention using pieces of prior art is impermissible absent some teaching or suggestion combine elements of the prior art.[1] The cited art does not suggest their combination and the Examiner provides no motivation to combine them. Yamamura does not mention a glaze, as in Sara, or an insulating coating or microspheres, as in Whittemore. Sara is unconcerned with insulating coatings or microspheres. Whittemore teaches a refractory mix for a non-carbonaceous brick, which lacks carbon. A carbon-free brick does not need an "oxidation prohibitive coating," i.e., a glaze.

Even assuming the cited art includes some suggestion to combine their disparate elements, Applicants cannot identify any inference to combine the separate elements in the configuration taught by the pending claims. As explained in the specification of the pending application, prior art has produced a refractory piece having a glaze coating covered by an insulating coating. This configuration has proved inferior to the present invention in which the glaze is applied over the insulating coating. Certainly, the cited art does not suggest the configuration, which is described by claims 2-6.

For all of the above reasons, the Examiners rejection for obviousness cannot be sustained. Claims 2-6 are allowable over Yamamura, Sara and Whittemore.

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[1] "It is impermissible to use the claimed invention as an instruction manual or 'template' to piece together the teachings of the prior art so that the claimed invention is rendered obvious. This court has previously stated that '[o]ne cannot use hindsight reconstruction to pick an choose among isolated disclosures in the

In light of the above, Applicants respectfully submit that claims 1-6 and 14-18 are patentable over the prior art. Early and favorable action is earnestly solicited.

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prior art to deprecate the claimed invention." *In re Fritch*, 972 F.2d 1260, 23 U.S.P.Q. 2d 1780, 1784 (Fed. Cir. 1992) (Quoting *in re Fine*, 837 F.2d 1071, 1075, 5 U.S.P.Q. 2d 1596, 1600 (Fed. Cir. 1988)).